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INFORMATION REPORT

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SUBJECT Soviet Activities in Applied Chemical Kinetics

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1. It appears that Yu A Ryabinin is one of the principal Soviet laboratory investigators concerned with the application of the ballistic piston to high speed kinetics. He has developed a small ballistic piston similar to the one utilized at the US Naval Ordnance Laboratory for the investigation of the pressure-volume-temperature relations of the products of reactions of propellants in guns. The primary work to date has related to the preparation of nitric oxide and acetylene. The references listed at the end of this report appear to be pertinent. The use of interchange between kinetic energy and internal energy as a means of rapidly changing the thermodynamic state of a compressible fluid is an obvious extension of these ballistic piston techniques.

2. Ballistic pistons are essentially of the free piston design and involve a long tube within which a closely fitting piston is permitted to slide. It is accelerated by a high pressure gas on one side and a low pressure gas sample on the other. The rapid movement of the free piston compresses the gas almost isotropically to a high pressure and temperature. The conditions attained are markedly a function of the thermodynamic properties of the gaseous mixture. The Soviets have used argon as an additive in order to increase the temperature rise for a given change in pressure. The primary instrumentation required involves means of measuring the initial pressures of the gas sample and the driving gas and suitable ballistic chronographic techniques to determine the velocity of the piston as a function of time. Variation in weights of the free piston and ratios of driving to sample, permit a wide variation in the rate of temperature change, the dwell-time at the end of the stroke, and in the rate of cooling. However, with such simple equipment, equal rates of heating and cooling, except for changes in the chemical properties of the gas, are obtained.

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3. Although the specific reference is not at hand, it is understood that the Soviets have developed "chemical engines" which are essentially extremely heavy equipment of the Diesel type, which type has been found useful for preparing a wide variety of products including acetylene, formaldehyde, and other organic chemical products.

4. [redacted] 25X1

it appears that personnel and facilities associated with Yu A Ryabinin offer a lead in this connection. It is believed that his activities are more closely associated with the ballistic piston than with industrial application. Organizations concerned with liquid fuel jet propulsion and high speed gas dynamics should be fruitful sources of investigation since these organizations in the US have shown interest in the chemical manufacturing possibilities of interchanges between kinetics and internal energy.

5. [redacted] 25X1

25X1 [redacted] it is to be expected that personnel in East Germany who were concerned with liquid fuel jet propulsion might well have directed their interests to high speed kinetics particularly since the East German government has been actively supporting the synthetic manufacture of petrochemicals from available raw materials.

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7. [redacted] 25X1

Soviets are very much interested in applied chemical kinetics are the following:

a. "Formation of Nitric Oxide on Adiabatic Compression of Air Mixtures", by Yu N Ryabinin, A M Markevich, and I I Tamm, Dok. Akad. Nauk, (USSR), 95, No 1, 111-113 (1954).

b. (title not available to me) Yu N Ryabinin, A M Markevich, I I Tamm, Dok. Akad, Nauk (USSR), 94, No 6, (1953).

c. "Production of Very High Pressures and Temperatures by the Method of Adiabatic Compression", Yu N Ryabinin, Zhur. Eksptl. i Teoret. Fiz., 23, No 4, 461 (1952).

d. "Concerning the Theory of Spontaneously Accelerating Reactions", X V Gorbachey, Zhur. Fiz. Khim., 26, No 10, 1504-1515, October 1952.

e. "Some Problems Connected with the Energetics of Chemical Reactions during the Presence and Absence of Static Equilibrium: II. Reactions in Systems Lacking Equilibrium" by A Ye Shtandel', Zhur. Fiz. Khim. (USSR), 26, No 11, 1549-1560, November 1952.

f. "Kinetic Analysis of Chain Reactions: III. General Integrals of Systems of Differential Kinetic Equations for the Initial Stages of Chain Reactions" by S Vasil'yev, Zhur. Fiz. Khim. (USSR), 27, No 7, 1081-1089, July 1953.

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